
Space Weather Technical Forecast

Issued on Thursday, 18 April 2024 at 01:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Further M-flares likely and a slight chance of X-flares. Chance of G1/Minor Storm conditions day 1 and 3 (18 and 20 Apr).

Solar Activity: Activity is currently Moderate. The largest flare was an M1.6 event at 17/2208 UTC from AR3645. Background flux is well within C-class levels.

There are currently fourteen sunspot regions visible on the disc. AR3639 in the northeast remains the largest and most magnetically complex region, although there has been some reduction in areal extent and decay of the delta spot that was previously present. AR3634 in the northwest is the second largest, with a large lead and trailer spot, but few if any intermediate spots. AR3645 in the southeast has exhibited modest growth with the development of a number of mixed polarity spots and indications of perhaps a weak delta spot in the early formative stages. The region lies in an area with numerous other sunspot groups. Given the proximity of the numerous southeast regions this may increase flare activity from this quadrant of the disc. The remaining regions appear generally stable with little overall change in appearance.

A filament eruption was observed around 17/0200 UTC lifting off in the northern hemisphere, although unlikely to have any Earth-directed component as the bulk of material appears to be heading north away from the Earth-Sun line. Three separate, but slow CMEs were observed from an area near AR3638 late on 17 Apr. These may have a minor Earth-directed component, but have been analysed to be slow (below 300km/s) and would only be expected to be observed as weak transients on 22 or 23 Apr.

Solar Wind / Geomagnetic Activity: Solar wind parameters were indicative of minor CME influence during the period. Solar winds as observed by ACE at L1 were largely slow-ambient, but with a peak of 481km/s (slightly elevated) observed at 17/0938 UTC. Density was initially above average, but fell below average following the CME arrival around 07/0900 UTC. From around 17/1800 UTC density became more persistently average to above average. The Interplanetary magnetic field (IMF) strength, Bt, was weak initially, but became predominantly moderate following the arrival of the CME, with a maxima of 10nT at 17/2020 UTC. The north-south component, Bz, was weakly positive at first, becoming generally weakly to moderately negative between 17/0900-1800 UTC, then largely weakly positive thereafter. Phi angle varied periodically between positive (away from the Sun) and negative (towards the Sun) sectors. Resultant geomagnetic activity ranged from Kp1 (Quiet) to Kp3 (Unsettled).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES-18 was at background. High energy electron flux (greater than 2MeV) observed at GOES-16 was background to moderate. The associated 24-hour fluence remained below Active (1e8 integrated flux) with a value of 9.16e5 integrated pfu observed at 17/2359 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is forecast with isolated M-class flares likely and a slight chance of X-class flares.

Solar Wind / Geomagnetic Activity: A CME that left the Sun on 15 Apr is expected to give a

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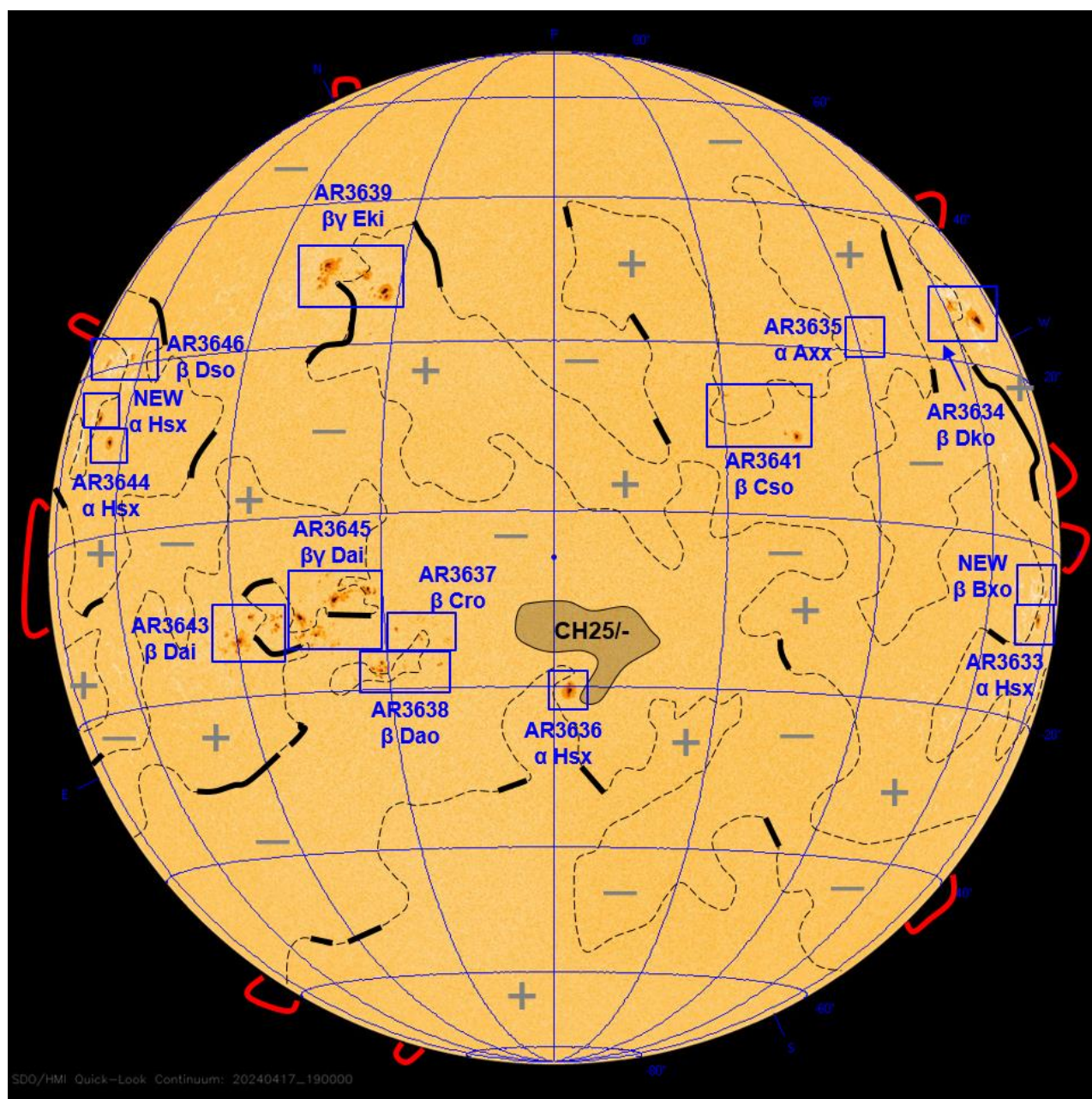
glancing impact at Earth early on day 1 (18 Apr). A second CME that occurred late on 16 Apr has been analysed as a likely miss below Earth orbit on day 3 (21 Apr).

Solar winds are currently at normal background speeds. A minor enhancement is expected with the anticipated arrival of the CME from 15 Apr, early on day 1 (18 Apr). A recurrent coronal hole high-speed stream is expected to become geoeffective on day 3 (20 Apr) likely increasing speeds to slightly elevated or elevated levels, continuing into day 4 (21 Apr).

Geomagnetic activity is expected to be at Quiet to G1/Minor Storm levels on day 1 (18 Apr), then Quiet to Unsettled on days 2 and 3 (19 and 20 Apr), likely increasing Unsettled to G1/Minor Storm levels during day 3 (19 Apr). On day 4 (21 Apr) activity is forecast at Quiet to Unsettled levels.

Energetic Particles / Solar Radiation: High energy proton flux as observed by GOES-18 is expected to persist at background. High energy electron flux as observed by GOES-16 is expected to remain at background to moderate levels. The associated 24hr electron fluence is expected to remain below the Active ($1e8$ integrated pfu) threshold.

Figure 1. Solar Analysis Valid 17/1900 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A CME that left the Sun following a flare and subsequent filament eruption from the southeast disc near AR3636 on 15 Apr is expected to give a glancing impact at Earth early on day 1 (18 Apr). A large filament eruption from the southeast disc late on 16 Apr has been analysed as a likely miss below Earth orbit on day 3 (21 Apr).

Solar winds are currently at slow-ambient speeds. A minor enhancement is expected with the anticipated arrival of the CME from 15 Apr, early on day 1 (18 Apr). Coronal hole 25 is expected to become geoeffective on day 3 (20 Apr). This is a persistent feature and gave peak speeds of around 550km/s on the previous rotation. The coronal hole itself appears smaller than on the previous rotation, though its equivalent position on the disc remains similar, so persistence forecasting for the onset carries moderately-high confidence, though likely with lower peak speeds than seen in March, estimated to be around 500km/s. This feature is not adequately modelled by Enlil presently.

Geomagnetic activity is expected to be at Quiet to G1/Minor Storm levels on day 1 (18 Apr), then Quiet to Unsettled on days 2 and 3 (19 and 20 Apr), likely increasing Unsettled to G1/Minor Storm levels during day 3 (19 Apr). On day 4 (21 Apr) activity is forecast at Quiet to Unsettled levels.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	30	5	20	5
Strong	G3	No	5	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
15/0549 UTC	Partial	Flare and Filament eruption	SE	640 km/s	18/0300 UTC +/- 6 hours	Low confidence

Radio Blackouts - X-Ray Flares:

Solar activity is currently Moderate with fourteen sunspot regions populating the visible disc and background flux well within C-class level. The majority of recent activity has originated from the cluster of sunspots in the southeast, mainly AR3645 (Dai/Beta-Gamma). This region has exhibited modest growth with the development of a number of mixed polarity spots and indications of perhaps a weak delta spot in the early formative stages. The region lies close to several other sunspot groups and given the close proximity of these regions provides additional magnetic complexity to this area, which could elevate the likelihood of further significant flares should the regions persist.

The largest regions on the disc remain AR3639 (Eki/Beta-Gamma) in the northeast and AR3634 (Dko/Beta) in the northwest, although both have undergone slight decay during the past 24 hours. The remaining regions appear generally stable with little change since the previous analysis.

Overall Moderate activity is forecast to continue, with isolated M-class flares likely and a slight chance of X-class flares, the risk remaining consistent through the period pending further developments.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	10	10	10	10

Solar Radiation Storms - (High Energy Protons):

High energy proton flux as observed by GOES-18 has persisted at background levels and is expected to generally remain so. There is a slight chance of the observed flux increasing in response to any notable flares however, primarily from AR3634 at first with this region moving towards the western limb. As the region rotates over the western horizon by day 3 (20 Apr) other regions currently in the eastern disc will be in a more favourable position for proton rich flares to be observed at GEO.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	5	5	10	10
Very Active	$\geq \text{S3}$ *	No	1	1	1	1
* S3 $\geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)						

High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy electron flux as observed by GOES-16 is expected to remain at background to moderate levels with enhanced geomagnetic activity expected to generally suppress values in the coming days.

The associated 24hr electron fluence is expected to remain below the Active ($1\text{e}8$ integrated pfu) threshold, with current REFM output accepted as good guidance.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	1	1
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 2: Latest MOSWOC REFM forecast with recurrence

